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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/772,109      | 02/03/2004  | Jeremie Dalton       | NOVLP082/002893     | 4875             |

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| EXAMINER |
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STARK, JARRETT J

| ART UNIT | PAPER NUMBER |
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2823

DATE MAILED: 11/16/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

|                              |                        |                     |  |
|------------------------------|------------------------|---------------------|--|
| <b>Office Action Summary</b> | <b>Application No.</b> | <b>Applicant(s)</b> |  |
|                              | 10/772,109             | DALTON ET AL.       |  |
|                              | <b>Examiner</b>        | <b>Art Unit</b>     |  |
|                              | Jarrett J. Stark       | 2823                |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 10/6/2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-23 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)          | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## DETAILED ACTION

### *Response to Arguments*

Applicant's arguments with respect to claims 1-23 have been considered but are moot in view of the new ground(s) of rejection.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claims 1-23** are rejected under 35 U.S.C. 103(a) as being unpatentable over Lopatin et al. (US 2005/0085031) in view of Erbil (US 4,927,670).

**Regarding claim 1**, Lopatin discloses a method of protecting an exposed copper surface of a partially fabricated IC from oxidation during exposure to an oxygen-containing environment, the method comprising:

contacting the exposed copper surface with a metallocene compound; and  
contacting the exposed copper surface with the oxygen-containing environment,  
whereby exposure to the metallocene compound minimizes formation of copper oxide on the exposed copper surface (Lopatin, [0009]);

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wherein the metallocene compound contains a metal bound to one or more cyclopentadienyl ligands (Lopatin's provisional application discloses "cyclopentadienyl ligands" bound to a metal on page 25 line 1).

Lopatin does not explicitly teach contacting the exposed copper surface with a metallocene compound to passivate the exposed copper surface. Lopatin's disclosed ALD process does not passivate the copper surface, Lopatin's surface remains active. Lopatin does however disclose in prior art Copper surfaces are conventionally passivated in order to prevent oxidation.

[0008] However, copper readily forms copper oxide when exposed to water and atmospheric conditions or environments outside of processing equipment and requires a passivation layer to prevent metal oxide formation. Metal oxides can result in an increase in the resistance of metal layers, become a source of particles and reduce the reliability of the overall circuit.

At the time of the invention it was known to one of ordinary skill in the art to form surface passivation layers by exposure to a metallocene compound. For example Erbil discloses the method of forming surface passivation layers by a CVD process using cyclopentadienyl metal compound precursors and an oxidizing agent. (Erbil, Abstract & Col. 12 line 3 → "products of this invention have a number of uses ... surface passivation")

It would have been within the scope of one of ordinary skill in the art at the time of the invention to combine the teachings of Lopatin and Erbil to enable the passivation step of Lopatin to be performed according to the teachings of Erbil because one of ordinary skill in the art at the time of the invention would have been motivated to look to

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alternative suitable methods of performing the disclosed passivation step of Lopatin and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

**Regarding claim 2, Lopatin in view of Erbil discloses the method of claim 1,** wherein the metallocene contains a metal selected from the group consisting of ruthenium, cobalt, nickel, iron, palladium, platinum, titanium, chromium, osmium, and manganese (Lopatin, [0083] & Erbil, Col. 3 line 66- Col. 4 line 3 – Group VIII metals).

**Regarding claims 3 & 17, Lopatin discloses the method of claim 1 & 12,** wherein the metallocene is ruthenocene. (Erbil, Col. 3 line 66- Col. 4 line 3 – Group VIII metals includes ruthenium and a metallocene containing ruthenium is ruthenocene).

**Regarding claim 4, Lopatin in view of Erbil discloses the method of claim 1,** wherein contacting the exposed copper surface with a metallocene compound comprises flowing a gas containing metallocene over the partially fabricated IC (Lopatin, [0080] & Erbil, Col. 2 lines 5-23).

**Regarding claim 5, Lopatin in view of Erbil discloses the method of claim 1,** wherein contacting the exposed copper surface with the oxygen-containing environment comprises contacting the exposed copper surface with a compound that forms a solid phase layer on the partially fabricated IC (Lopatin, [0009] & Erbil, Col. 2 lines 5-23).

**Regarding claim 6,** Lopatin in view of Erbil discloses the method of claim 5, wherein the compound is a precursor compound that reacts with an oxygen-containing species to form the solid phase layer (Lopatin, [0009] & Erbil, Col. 2 lines 5-23).

**Regarding claim 7,** Lopatin in view of Erbil discloses the method of claim 1, wherein contacting the exposed copper surface with the oxygen-containing environment comprises contacting the exposed copper surface with a diffusion barrier precursor, which reacts with an oxygen-containing species to form a barrier layer on the partially fabricated IC (Lopatin, [0012] & Erbil, Col. 2 lines 5-23).

**Regarding claim 8,** Lopatin in view of Erbil discloses the method of claim 7, wherein the oxygen-containing species is molecular oxygen (Lopatin, [0008] & Erbil, Col. 2 lines 5-23).

**Regarding claim 9,** Lopatin in view of Erbil discloses the method of claim 1, wherein contacting the exposed copper surface with the oxygen-containing environment comprises contacting the exposed copper surface with an etch stop precursor, which reacts with an oxygen-containing species to form an etch stop layer on the partially fabricated IC (Lopatin, [0009] & Erbil, Col. 2 lines 5-23).

**Regarding claim 10,** Lopatin in view of Erbil discloses the method of claim 1, wherein contacting the exposed copper surface with the oxygen-containing environment comprises contacting the exposed copper with the ambient or other oxygen-containing environment during storage or transport between processing modules (Lopatin, [0008] & Erbil, Col. 2 lines 5-23).

**Regarding claim 11,** Lopatin in view of Erbil discloses the method of claim 1, wherein the exposed copper surface comprises a copper seed layer on the partially fabricated IC (Lopatin, [0016] & Erbil, Col. 2 lines 5-23).).

**Regarding claim 12,** Lopatin in view of Erbil discloses a method of passivating and using an exposed copper surface of a partially fabricated IC, the method comprising:

contacting the exposed copper surface with a metallocene compound to thereby passivate the surface (Lopatin, [0083]) ; and

wherein the metallocene compound contains a metal bound to one or more cyclopentadienyl ligands (Lopatin's provisional application discloses "cyclopentadienyl ligands" bound to a metal on page 25 line 1) and

depositing a layer of material on the partially fabricated IC using an oxygen-containing deposition chemistry (Lopatin, [0009]).

**Regarding claim 13,** Lopatin in view of Erbil discloses the method of claim 12 further comprising performing the contacting and depositing step in a single chamber. (Lopatin, Claim 65 & Erbil, Col. 2 lines 5-23).

**Regarding claim 14,** Lopatin in view of Erbil discloses the method of claim 12 wherein the depositing is conducted using the metallocene compound as a chemical precursor to the material. (Lopatin, [0083] & Erbil, Col. 3 line 66- Col. 4 line 3)

**Regarding claim 15,** Lopatin in view of Erbil discloses the method of claim 12 wherein the contacting and depositing operations are done concurrently. (Erbil, Col. 2 lines 5-23).

**Regarding claim 16,** Lopatin in view of Erbil discloses the method of claim 12, wherein the metallocene is contains a metal selected from the group consisting of ruthenium, cobalt, nickel, iron, palladium, platinum, titanium, chromium, osmium, and manganese (Lopatin, [0083] & Erbil, Col. 3 line 66- Col. 4 line 3)

**Regarding claim 18,** Lopatin in view of Erbil discloses the method of claim 12, wherein contacting the exposed copper surface with a metallocene compound comprises flowing a gas containing metallocene over partially fabricated IC. (Lopatin, [0080] & Erbil, Col. 2 lines 5-23).

**Regarding claim 19,** Lopatin in view of Erbil discloses the method of claim 12, wherein the depositing of a layer of material comprises contacting the exposed copper surface with a compound that forms a solid phase layer on the partially fabricated IC (Lopatin, [0009] & Erbil, Col. 2 lines 5-23).

**Regarding claim 20,** Lopatin in view of Erbil discloses the method of claim 12, wherein the depositing of a layer of material comprises contacting the exposed copper surface with a diffusion barrier precursor, which reacts with an oxygen-containing species to form a barrier layer on the partially fabricated IC (Lopatin, [0009] & Erbil, Col. 2 lines 5-23).

**Regarding claim 21,** Lopatin in view of Erbil discloses the method of claim 20, wherein the oxygen-containing species is molecular oxygen (Lopatin, [0008] & Erbil, Col. 2 lines 5-23).

**Regarding claim 22,** Lopatin in view of Erbil discloses the method of claim 12, wherein depositing a layer of material comprises



contacting the exposed copper surface with an etch stop precursor, which reacts with an oxygen-containing species to form an etch stop layer on the partially fabricated IC (Lopatin, [0009] & Erbil, Col. 2 lines 5-23).

**Regarding claim 23**, Lopatin in view of Erbil discloses the method of claim 12, wherein the exposed copper surface comprises a copper seed layer on the partially fabricated IC (Lopatin, [0016]).

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.


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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jarrett J. Stark whose telephone number is (571) 272-6005. The examiner can normally be reached on Monday - Thursday 7:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JJS  
November 9, 2006

  
Fernando L. Toledo  
Primary Examiner  
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